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Clamart, August 23, 2005

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Dear Sirs,

Further to Written Opinion of the International Searching Authority dated July 8th 2005 for the above referenced international patent application, please find enclosed the new set of claims and comments of the Applicants.

Re Item IV

Lack of unity of invention

The Applicants cancel without prejudice claims 12 to 22 as filed, corresponding to Group II of the invention.

Re Item V

Support to the set of claims

New set of claims is proposed as follow (Replacement and marked sheets are enclosed).

Claim 1 is based on claims 1, 3, 5 and 6 as filed, Figure 3 and page 9, paragraph 48 of the description as filed. Claims 2 to 4 correspond to renumbered claims and have been clarified.

New claim 5 is based on claims 12 and 17 as filed, combination of first and second

embodiment of the invention (Group I and II) is based on the description page 16, paragraph 80 as filed. New claim 6 is based on claim 16 as filed.
Claim 7 is based on claims 7, 10 and 11 as filed and page 9, paragraph 48 of the description as filed and has been changed to a recovering method. Claims 8 and 9 correspond to renumbered claims and have been clarified.

Documents of Prior Art are referenced as follow:
D1: US-A-4 650 581
D2: DE 31 51 749
D3: EP-A-0 702 991
D4: DE 296 16 832
D5: EP-A-0 566 035
D6: US-A-4 022 694
D7: US-A-4 123 365

Novelty
D1 refers to an apparatus for separating a dispersed phase from a continuous phase. The apparatus comprises a coalescing element which coalesces the dispersed phase in oil drops; the coalescing element is constituted by an enrolled guide made of a lipophilic material (column 5, lines 31-35) preferably a rigid fluorocarbon resin (column 6, lines 30-45; columns 6-7, lines 67-6). The apparatus further comprises a spiral guide which transports in the form of liquid filaments the drops for recovery: the goide is constituted by a material with a high vacuum coefficient and hydrophobic properties (column 5, lines 47-52).
The coalescing element is not made of a reusable and absorbent polymer; therefore the coalescing element has not the two further technical features which are the reuse of the coalescing element and the absorbance properties of the coalescing element.

D2 refers to a separation oil/water apparatus. The apparatus comprises a coalescing filter element made of a crystal-granular material (page 14, lines 16-20) which coalesces oil drops from an emulsion. The apparatus further comprises a collector which collects the oil drops.
No reference to reusable and absorbent material is made; the collector does not allow the water to flow through the collector.

D3 refers to a separation oil/water apparatus. The apparatus comprises a coalescing filter element made of a granular material as shown on figures; no other information on the material is present in the document. The coalescing filter element coalesces the oil disperse phase in oil drops. The apparatus further comprises a collector which collects the oil drops.
No reference to reusable and absorbent material is made; the collector does not allow the water to flow **through** the collector.

D4 refers to a separation oil/water apparatus. The apparatus comprises a coalescing element which seems to be a grid (page 3, paragraph 1); no other information on the material is present in the document. The coalescing filter element coalesces the oil disperse phase in oil drops. The apparatus further comprises a collector which collects the oil drops and transports them to recovery.
No reference to reusable and absorbent material is made; the collector does not allow the water to flow **through** the collector.

D5 refers to an apparatus for separating a dispersed phase from a continuous phase and a solid phase. The apparatus comprises a coalescing element which coalesces the dispersed phase in drops; the coalescing element is constituted by a fibrous material (column 3, line 22). The apparatus further comprises a collector which collects the drops and separates the solid particles.
No reference to reusable and absorbent material is made; the collector does not allow the water to flow **through** the collector; further solid particles are present.

D6 refers to an oil-water separation apparatus. The apparatus compriaes a separation element which absorbs and coalesces the dispersed phase in oil drops; the coalescing element is constituted by a porous re-generable material made of a polyurethane foam (column 3, lines 9-21; columns 4, lines 24-37). The apparatus further comprises a separation means which avoid contamination of the clean water by the recovered oil drops: the separation means is a weir plate.
The separation means has not the same feature in D6 as it has in our invention. The separation means as explained (column 3-4, line 66 to line 6) "avoids contamination of the clean water and increases gravity separation by creating an upward flow of the effluent in the

chamber". Even if the Applicants concede that the separation means could be interpreted as a guide for the detached large drops, the separation means does not allow the water to flow **through** the separation means. Furthermore, as explained (column 4, line 38 to line 60) the flow through the foam block is not constant, effectively "at a certain level of oil saturation of foam pad, (…) the flow of water is then stopped and regeneration of foam block is accomplished by moving perforated plate (…)"; therefore, in D6 the large drops are **not** further detached from the coalescing element upon a flow of the emulsion fluid, but they are detached upon the move of the perforated plate. In our invention, **all** the large drops are detached from the coalescing element upon flow of the emulsion fluid.

Claim 1 as described is new regarding the cited documents D1 to D6. Same argumentation applies to claim 7. Dependents claims are also new. So, the set of claim is new.

Inventive Step

As stated above, two documents stand out of cited prior art: D1 and D6.

D2 to D5 refer to separation apparatus with collector and not a guide or a separation means as sought in our invention.

Both documents D1 and D6 refer to an apparatus for separation of oil from water and could be taken as closest prior art.

- D6 in view of D1:

D6 refers to a separation apparatus with, it seems, an estimated flow rate, relatively low of 1.4 gallons per minute (3.8L/min or 230L/h) and not continuously because with this system of compression of the foam for recovery of oil in porous geometry of the foam. Our invention provides a better efficiency with a flow rate between 5 m^3/h to 16 m^3/h. The objective technical problem to be solved is to design a separation apparatus with an increased flow rate. The guiding means of D1 teaches on better efficiency, because avoiding the problem of refractionation, but nothing on better flow rate. Furthermore, the fact that the separation means in D6 is a weir plate is fundamental to create a channelling between oil and water. The skilled in the art will avoid changing the separation means by a guiding and separation means where the continuous phase can flow through it, because the guiding and separation means does not increase the flow rate and is in contradiction with the principle of channelling.

- D1 in view of D6:

D1 refers to a separation apparatus with a cartridge which is not made of a reusable and absorbent material. The reusable material avoids pollution and waste recycling. The absorbent material ensures that the separation is made with a better efficiency and higher sensibility, allowing reducing the oil-in-water content of well tests separator water from a few percents to a few tens of ppm, typically from 2% (20,000 ppm) to 10 ppm. Effectively, mechanical systems for coalescing emulsion have not a high sensibility to small droplets. The objective technical problem to be solved is to design a separation apparatus with a better efficiency and sensibility to smaller droplets. First, D6 does not teach that the absorbent material has a better efficiency and sensibility to smaller droplets. Secondly, D6 teaches that the absorbent material becomes saturated and the flow rate is then stopped. The skilled in the art reading this, will avoid using such a material because the problem occurring in D6 is exactly the problem that he is trying to solve in D1 (column 1, lines 41-42: "[system which] tends to rapidly clog").

Claim 1 as described involves an inventive step regarding the cited documents D1 and D6. Same argumentation applies to claim 7. Dependents claims are also involved inventive step. So, the set of claim involves an inventive step.

Yours faithfully,

Hélène Raybaud
European Patent Attorney

Encs.

Claims

[c1] A system for separating a water/hydrocarbons emulsion fluid into a recovered oil fluid and a purified water fluid, the water/hydrocarbons emulsion fluid comprising a continuous phase and a dispersed phase, the purified water fluid being essentially constituted of the continuous phase, the system comprising:

a vessel (38, 48) at an inlet of which the water/hydrocarbons emulsion fluid may flow;

one or more coalescing element (37a, 37b) made of Reusable Polymer Absorbent material, each coalescing element allowing to coalesce at least a portion of the dispersed phase from small droplets into large drops, said large drops being further detached from the coalescing element upon a flow of the emulsion fluid;

one or more separating and guiding means (33a, 33b, 43), each separating and guiding means being associated with one coalescing element and being disposed at an output of the associated coalescing element to guide said detached large drops for further recovery and having a structure that is adapted to allow the continuous phase to flow through the separating and guiding means.

[c2] The system of claim 1, further comprising:

one or more bed (31a, 31b), each bed allowing to support one coalescing element (37a, 37b) made of Reusable Polymer Absorbent material;

one or more recovery outlet (39a, 39b), each recovery outlet allowing to recover the recovered fluid from large drops detached from one coalescing element (37a, 37b).

[c3] The system of claim 1 or 2, wherein each separating and guiding means is substantially located at 10 millimeters of the associated coalescing element so as

to allow a burst of bubbles (41) of the continuous phase, the bubbles being surrounded by a film of the dispersed phase, and the bubbles being formed between the coalescing element and the separating and guiding means.

[c4] The system according to any one of claims 1 to 3, wherein each separating and guiding means comprises:

a plurality of plates (51) to intercept said detached large drops; wherein:

the plurality of plates (51) are made of an oleophilic material so that the intercepted large drops adhere to the plates;

the plurality of plates (51) have a diagonal orientation adapted for guiding the adhered large drops upward.

[c5] The system according to any one of claims 1 to 4, comprising at least two coalescing elements and further comprising one or more weir (74a, 74b), each weir being associated with one coalescing element, said weir being located along and at an upstream side of the associated coalescing element, and said weir allowing to prevent the detached large drops of an upstream coalescing element to flow through the associated coalescing element.

[c6] The system of claim 5, wherein each weir is located at an upper portion of the vessel.

[c7] A method for recovering from a water/hydrocarbons emulsion fluid a recovered oil fluid and a purified water fluid, the water/hydrocarbons emulsion fluid comprising a continuous phase and a dispersed phase, the purified water fluid being essentially constituted of the continuous phase, the method comprising :

providing a flow of at least a portion of the water/hydrocarbons emulsion fluid through at least one bed (31a, 31b) within a vessel (38, 48), each bed supporting a coalescing element (37a, 37b) made of Reusable Polymer

Absorbent material, whereby at least a portion of the dispersed phase coalesces from small droplets into large drops;

detaching said large drops from each bed (31a, 31b) by means of a flow velocity;

guiding the detached large drops with at least one separating and guiding means (33a, 33b, 43), the at least one separating and guiding means being associated with the at least one bed (31a, 31b), said separating and guiding means having a structure that is adapted to allow the continuous phase to flow through the separator packing;

recovering the recovered oil fluid from the guided large drops; and

recovering the purified water fluid from the continuous phase.

[c8] The method of claim 7, further comprising: repeating the coalescing, the detaching, the guiding and the recovering steps at a further location of the vessel (38, 48).

[c9] The method of claim 7 or 8, further comprising:

intercepting the detached large drops with at least one plate (51) of the separating and guiding means, the large drops adhering onto the at least one plate;

guiding the adhered large drops along the at least one plate (51) upon a flow velocity.

Claims

[c1] A system for separating a water/hydrocarbons emulsion fluid into a recovered oil fluid and a purified water fluid, the water/hydrocarbons emulsion fluid comprising a continuous phase and a dispersed phase, the purified water fluid being essentially constituted of the continuous phase, the system comprising:

a vessel (38, 48) at an inlet of which the water/hydrocarbons emulsion fluid may flow;

one or more coalescing element (37a, 37b) made of Reusable Polymer Absorbent material, each coalescing element allowing to coalesce at least a portion of the dispersed phase from small droplets into large drops, said large drops being further detached from the coalescing element upon a flow of the emulsion fluid;

one or more separating and guiding means (33a, 33b, 43), each separating and guiding means being associated with one coalescing element and being disposed at an output of the associated coalescing element to guide said detached large drops for further recovery and having a structure that is adapted to allow the continuous phase to flow through the separating and guiding means.

[c2] The system of claim 1, further comprising:

one or more bed (31a, 31b), each bed allowing to support one coalescing element (37a, 37b) made of Reusable Polymer Absorbent material;

one or more recovery outlet (39a, 39b), each recovery outlet allowing to recover the recovered fluid from large drops detached from one coalescing element (37a, 37b).

[c3] The system of claim 1 or 2, wherein each separating and guiding means is substantially located at 10 millimeters of the associated coalescing element so as

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Deleted: <#>The system according to any one of claims 1 to 2, wherein ¶ <#>the guiding means (33a, 33b, 43) is a separator packing, the separator packing having a structure that is adapted to allow the continuous phase to flow through the separator packing.¶

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to allow a burst of bubbles (41) of the continuous phase, the bubbles being surrounded by a film of the dispersed phase, and the bubbles being formed between the coalescing element and the separating and guiding means.

[c11] The system according to any one of claims 1 to 3, wherein each separating and guiding means comprises:

a plurality of plates (31) to intercept said detached large drops; wherein:

the plurality of plates (51) are made of an oleophilic material so that the intercepted large drops adhere to the plates;

the plurality of plates (51) have a diagonal orientation adapted for guiding the adhered large drops upward.

[c5] The system according to any one of claims 1 to 4, comprising at least two coalescing elements and further comprising one or more weir (74a, 74b), each weir being associated with one coalescing element, said weir being located along and at an upstream side of the associated coalescing element, and said weir allowing to prevent the detached large drops of an upstream coalescing element to flow through the associated coalescing element.

[c6] The system of claim 5, wherein each weir is located at an upper portion of the vessel.

[c7] A method for recovering from a water/hydrocarbons emulsion fluid a recovered oil fluid and a purified water fluid, the water/hydrocarbons emulsion fluid comprising a continuous phase and a dispersed phase, the purified water fluid being essentially constituted of the continuous phase, the method comprising :

providing a flow of at least a portion of the water/hydrocarbons emulsion fluid through at least one bed (31a, 31b) within a vessel (38, 48), each bed supporting a coalescing element (37a, 37b) made of Reusable Polymer

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the emulsion fluid is a produced water associated with a production of hydrocarbons;¶
the coalescing element is a Reusable Polymer Absorbent.¶

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Absorbent material, whereby at least a portion of the dispersed phase coalesces from small droplets into large drops;

detaching said large drops from each bed (31a, 31b) by means of a flow velocity;

guiding the detached large drops with at least one separating and guiding means (33a, 33b, 43), the at least one separating and guiding means being associated with the at least one bed (31a, 31b), said separating and guiding means having a structure that is adapted to allow the continuous phase to flow through the separator packing;

recovering the recovered oil fluid from the guided large drops; and

recovering the purified water fluid from the continuous phase.

[claim] The method of claim 7, further comprising: repeating the coalescing, the detaching, the guiding and the recovering steps at a further location of the vessel (38, 48).

[claim] The method of claim 7 or 8, further comprising:

intercepting the detached large drops with at least one plate (51) of the separating and guiding means, the large drops adhering onto the at least one plate;

guiding the adhered large drops along the at least one plate (51) upon a flow velocity.

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Deleted: <#>The method of any one of claims 7 to 10, wherein ¶
the emulsion fluid is a produced water accounted with a production of hydrocarbons;¶
the coalescing element is a Reusable Polymeric Absorbent.¶
<#>A system for separating an emulsion fluid into a recovered fluid and a purified fluid, the emulsion fluid comprising a continuous phase (65, 75), a dispersed phase (67) and a coalesced portion (66, 76), the purified fluid being essentially constituted of the continuous phase, the system comprising:¶
a vessel (68, 78) at an inlet of which the emulsion fluid may flow;¶
at least one bed (61, 71b) supporting a coalescing element (63, 73), the coalescing element allowing to coalesce at least a portion of the dispersed phase (67) into large drops (69, 79b) detached from the coalescing element upon a flow of the continuous phase;¶
at least one weir (64, 74) located along the at least one bed (61, 71b) at an upstream side of the at least one bed, each weir allowing to prevent the coalesced portion (66, 76) to flow through an associated bed. ¶
<#>The system of claim 12, further comprising :¶
a recovery outlet (62, 72) located at the upstream side of the bed (61, 71b);

The method of any one of claims 7 to 10, wherein :
the emulsion fluid is a produced water associated with a production of hydrocarbons;
the coalescing element is a Reusable Polymer Absorbent.

A system for separating an emulsion fluid into a recovered fluid and a purified fluid, the emulsion fluid comprising a continuous phase (65, 75), a dispersed phase (67) and a coalesced portion (66, 76), the purified fluid being essentially constituted of the continuous phase, the system comprising:
a vessel (68, 78) at an inlet of which the emulsion fluid may flow;
at least one bed (61, 71b) supporting a coalescing element (63, 73), the coalescing element allowing to coalesce at least a portion of the dispersed phase (67) into large drops (69, 79b) detached from the coalescing element upon a flow of the continuous phase;
at least one weir (64, 74) located along the at least one bed (61, 71b) at an upstream side of the at least one bed, each weir allowing to prevent the coalesced portion (66, 76) to flow through an associated bed.

The system of claim 12, further comprising :
a recovery outlet (62, 72) located at the upstream side of the bed (61, 71b), the recovery outlet allowing to recover the coalesced portion (66, 76).

The system of claim 13, wherein :
the coalesced portion (66) results from a pre-treatment of the emulsion fluid before flowing through the bed (61).

The system of claim 13, further comprising :
a plurality of beds (71a, 71b), each bed supporting an associated coalescing element (63, 73); and wherein
the coalesced portion (76) provides from previous large drops (79a) generated at a distinct previous bed (71a).

The system of any one of claims 12 to 15, wherein
the dispersed phase comprises oil droplets (67);
the weir (64, 74) is positioned at an upper portion of the vessel (68, 78).

The system according to any one of claims 12 to 16, wherein
the emulsion fluid is a produced water associated with a production of hydrocarbons;
the coalescing element is a Reusable Polymer Absorbent.

A method for separating in a vessel an emulsion fluid comprising a continuous phase (65, 75), a dispersed phase (67) and a coalesced portion (66, 76), into a recovered fluid and a purified fluid, the purified fluid being essentially constituted of the continuous phase, the method comprising:
preventing the coalesced portion (66, 76) to flow through a bed (61, 71b) located in the vessel;
coalescing at least a portion of the dispersed phase (67) into large drops (69, 79b), wherein the coalescing is performed by means of a coalescing element (63, 73) supported by the bed (61, 71b), and wherein the large drops (69, 79b) are detached from the coalescing element (63, 73) upon a flow of the continuous phase.

The method of claim 18, wherein :
the preventing is performed by inserting a weir (64, 74b) along the bed (61, 71b) at an upstream side of the bed.

The method of claim 19, wherein the coalesced portion (66, 76) results from a pre-treatment of the emulsion fluid within the vessel (68).

The method of claim 19, wherein the coalesced portion (66, 76) results from a coalescing action of a distinct coalescing element (73a) supported by a distinct previous bed (71a) within the vessel (68).

The method according to any one of claims 18 to 21, wherein
the emulsion fluid is a produced water associated with a production of hydrocarbons;
the coalescing element is a Reusable Polymer Absorbent.